Chapter 2
Study Area

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Description of the Study Area:

Both Broad Creek and the Okatee River are located in the Coastal Plains region of South Carolina in Beaufort County. For the purpose of this study, the upper portion of the Okatee River drainage system was selected to assess overall environmental quality and biological condition because it was comparable in size to the Broad Creek estuary. However, most existing Geographic Information System (GIS) land-use data layers available for these drainage systems encompass the entire hydrologic unit (14 digit HUC), which for the Okatee River includes areas not encompassed by the study area. The HUC for Broad Creek generally includes only the study area. Therefore we have utilized the HUC boundary for characterizing land cover features of both systems.

The two primary GIS data sources that were utilized to characterize both drainage systems were the Coastal Change Analysis Program (CCAP) data (Figures 2.1 and 2.3) and the National Wetlands inventory (NWI) of 1989 enhanced by 1994 aerial photography (Figures 2.2 and 2.4). The CCAP data omitted a small portion of land cover data in the upper extent of the Okatee River drainage system which was located in Jasper County. However, the NWI data included this section of the drainage area. Because of differences in the land use classification schemes between these two covers, these different sources of land use information are not directly comparable. Another data source utilized was the Beaufort County Tax Parcel Map and associated database.

Broad Creek drains the major area of Hilton Head Island in the southwestern portion of Beaufort County, SC. The NWI land use data shows the Broad Creek drainage as heavily urbanized, with approximately 80% of the upland area having residential and industrial development (Figure 2.2, Table 2.1). Based on tax map parcel information, the Broad Creek drainage area has more than 30% impervious surface, with roughly half of that being transportation related (Table 2.1, Milt Rhodes, 1999). The bulk of the remaining upland area is classified as forest.

Although the Okatee River is located only a few miles from Hilton Head, the drainage area includes a much lower percentage of impervious surface (15%) and transportation-related impervious surface area (2%) relative to Broad Creek (32% and 16% respectively) based on the tax map parcel data (Table 2.1). The NWI data also indicates a greater amount of agricultural lands than Broad Creek (Table 2.1, Figure 2.4), but with the vast majority of upland area classified as forest.

Despite a large difference in total watershed area, both drainage systems have very similar percentages of wet habitat in terms of open water and estuarine wetlands

(Table 2.1). Tax map parcels also show a surprising similarity in the percentage of upland (taxable) area.

The differences in the amount of residential and industrial development in Broad Creek versus the Okatee River are also evident in the amount of treated wastewater permitted for land application under State permits or direct discharge permitted under the National Pollutant Discharge Elimination System (NPDES) permits and the number of public water supply wells in each watershed. In the Okatee River watershed, there are only three permitted discharges, all of which are land application/spray field no discharge (ND) permits with a total permitted discharge of 0.444 million gallons per day (MGD) (Table 2.2, Figure 2.5) and only 13 public drinking water supply wells (Table 2.3, Figure 2.5). In contrast, the Broad Creek watershed has five 5 permitted discharges, one NPDES direct discharge and four land application/spray field no discharge (ND) permits with a total permitted discharge of 11.19 MGD, and 28 public drinking water supply wells (Tables 2.2 and 2.3, Figure 2.6). Within the Broad Creek watershed, none of the permitted discharges, ND or NPDES, are direct discharges to Broad Creek.

Another reflection of the different development histories in the two drainage systems is in the number of known contaminated groundwater sites. There are only four known contaminated sites in the Okatee River watershed (3 due to underground storage tanks, Table 2.4), and a total of 22 in the Broad Creek watershed (20 due to underground storage tanks and one due to an above -ground storage tank).

General Sampling Strategy:

Due to the diversity of habitats in each area and the likelihood that some habitats are more impacted by land use activities than others, each drainage system was divided into six discrete segments (strata) for sampling (Figures 2.7 and 2.8). These segments each encompassed approximately 1300 meters of mainstem channel in each estuary, beginning at the headwaters and ending at a point where the waters drain into a larger water body. All segments were approximately equal in length. Within each segment, one subtidal river water site (designated as "R"), one tidal creek (designated as "T"), and one oyster bed (designated as "O") were randomly selected. The tidal creeks sampled were of comparable type and were limited to those which receive drainage directly from upland areas. Note that Broad Creek tidal creek site T-2 actually originates in segment number one and has its discharge to Broad Creek near the boundary between segments one and two. No suitable tidal creeks could be found entirely within segment two. Three of the six segments in each drainage system also included one randomly placed intertidal river station (in Broad Creek, segments 1, 4, and 6; in the Okatee River, segments 2, 4, and 6).

The primary objective of this study was to provide a better understanding of existing conditions in different habitats of each drainage system using an unbiased sampling design. The study was not designed to target specific activities, such as evaluating the effects of marinas, boating activities, urban runoff, etc. Rather, it was designed to evaluate the integrated effects of all activities that may affect the quality of

these water bodies. The sampling was restricted to the summer months to maximize comparison with existing databases. This is also a period when some water quality variables, such as dissolved oxygen and nutrient concentrations, can be at their worst levels. The sampling effort to assess water quality, sediment quality and biological conditions in the various habitats and river segments is described in detail in the following chapters.

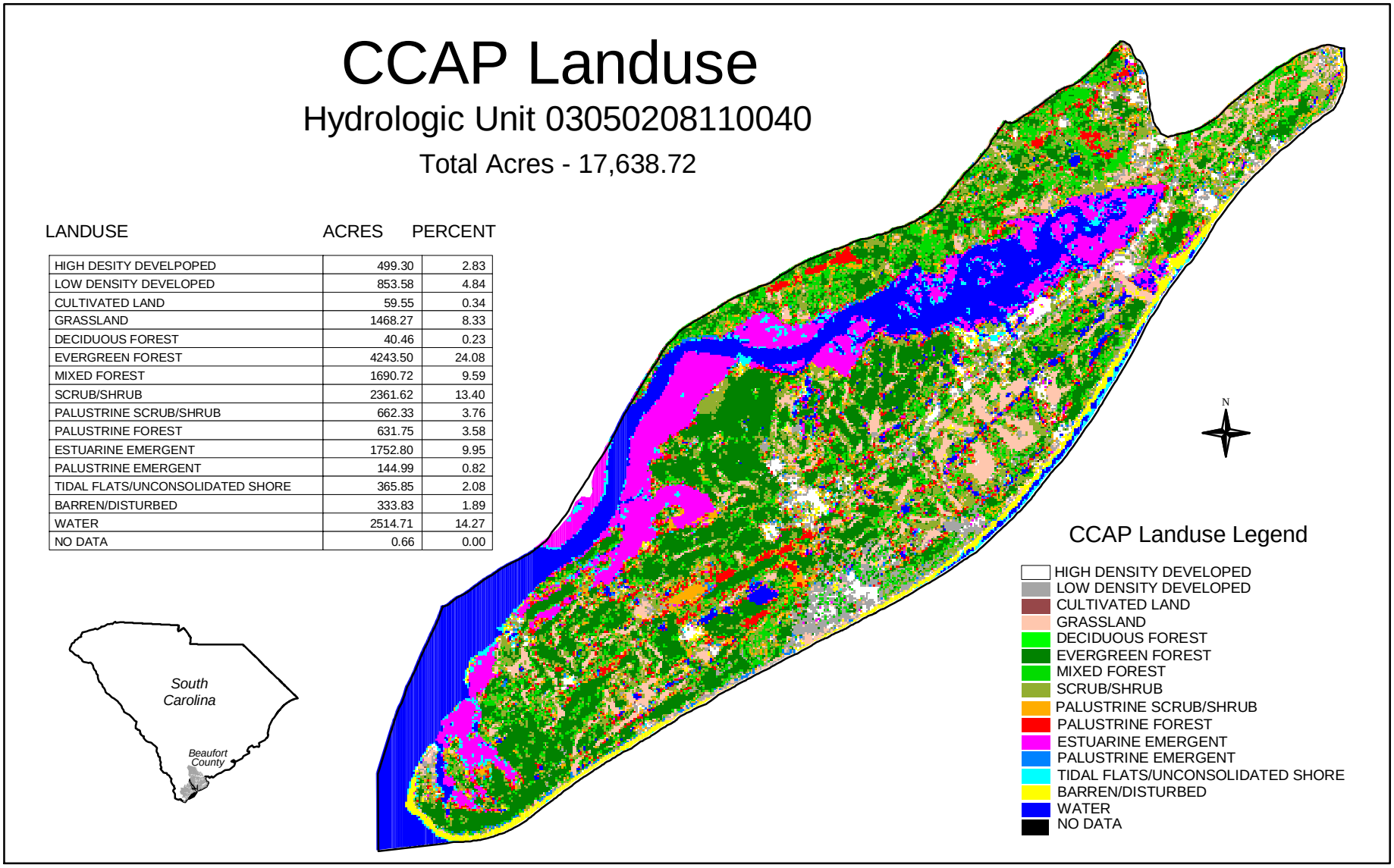


Figure 2.1. Coastal Change Analysis Program (CCAP) landuse classification for lower Hilton Head Island watershed.

National Wetland Inventory Landuse

Hydrologic Unit 03050208110040

Total Acres - 17,638.72

LANDUSE	ACRES	PERCENT
BAY/ESTUARY	2412.52	13.68
BEACHES	162.70	0.92
COMMERCIAL	641.43	3.64
CROPLAND/PASTURE	50.74	0.29
EVERGREEN UPLAND FOREST	799.54	4.53
FORESTED WETLAND	618.30	3.51
HERBACEOUS RANGELAND	41.09	0.23
MIXED UPLAND FOREST	1091.19	6.19
NON-FORESTED WETLAND	2380.88	13.50
OPEN WATER	784.92	4.45
OTHER URBAN	1236.85	7.01
RESIDENTIAL	7286.38	41.31
SANDY AREA	38.76	0.22
SHRUB/BRUSH RANGELAND	42.75	0.24
TRANSPORTATION/UTILITY	50.66	0.29

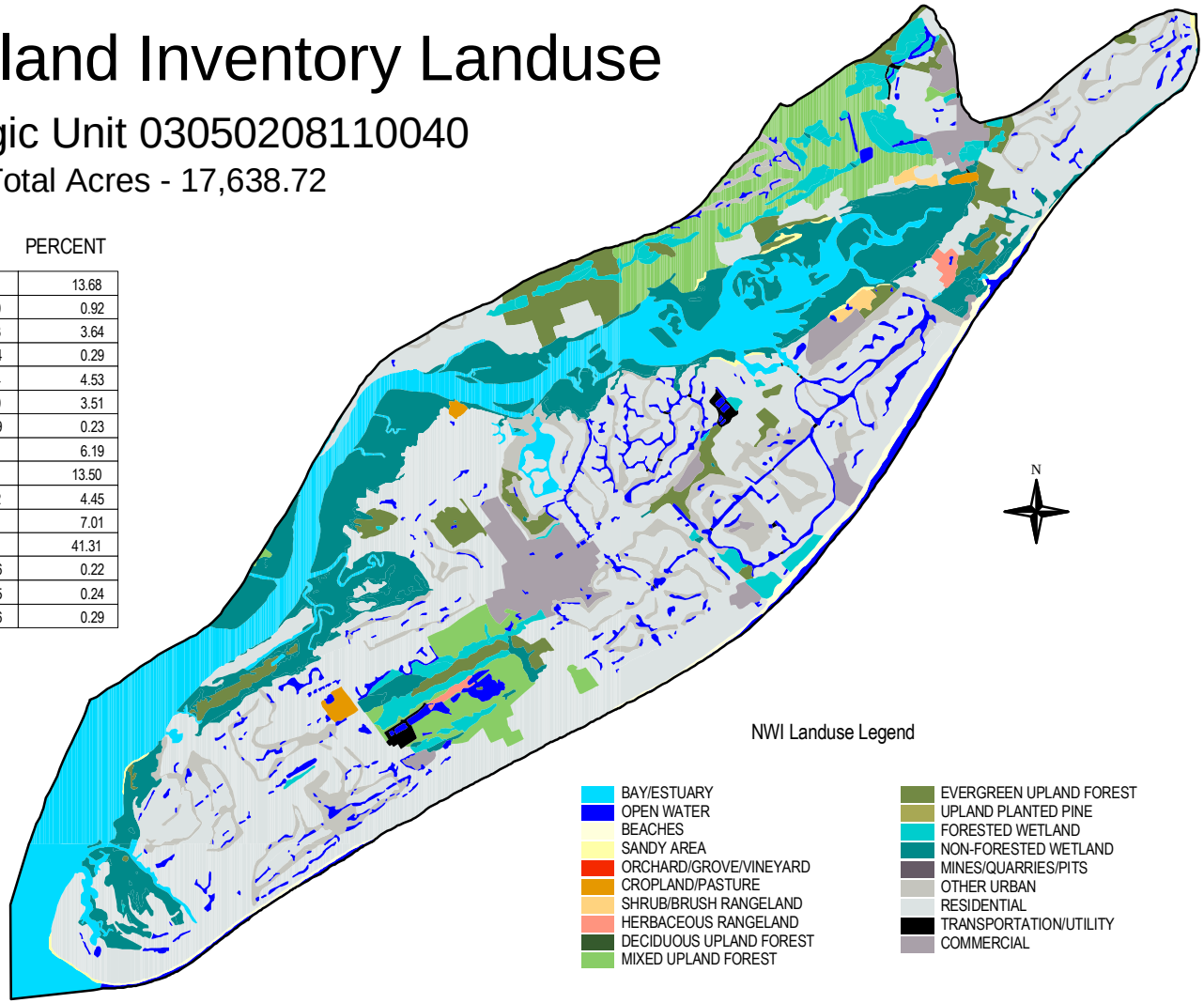
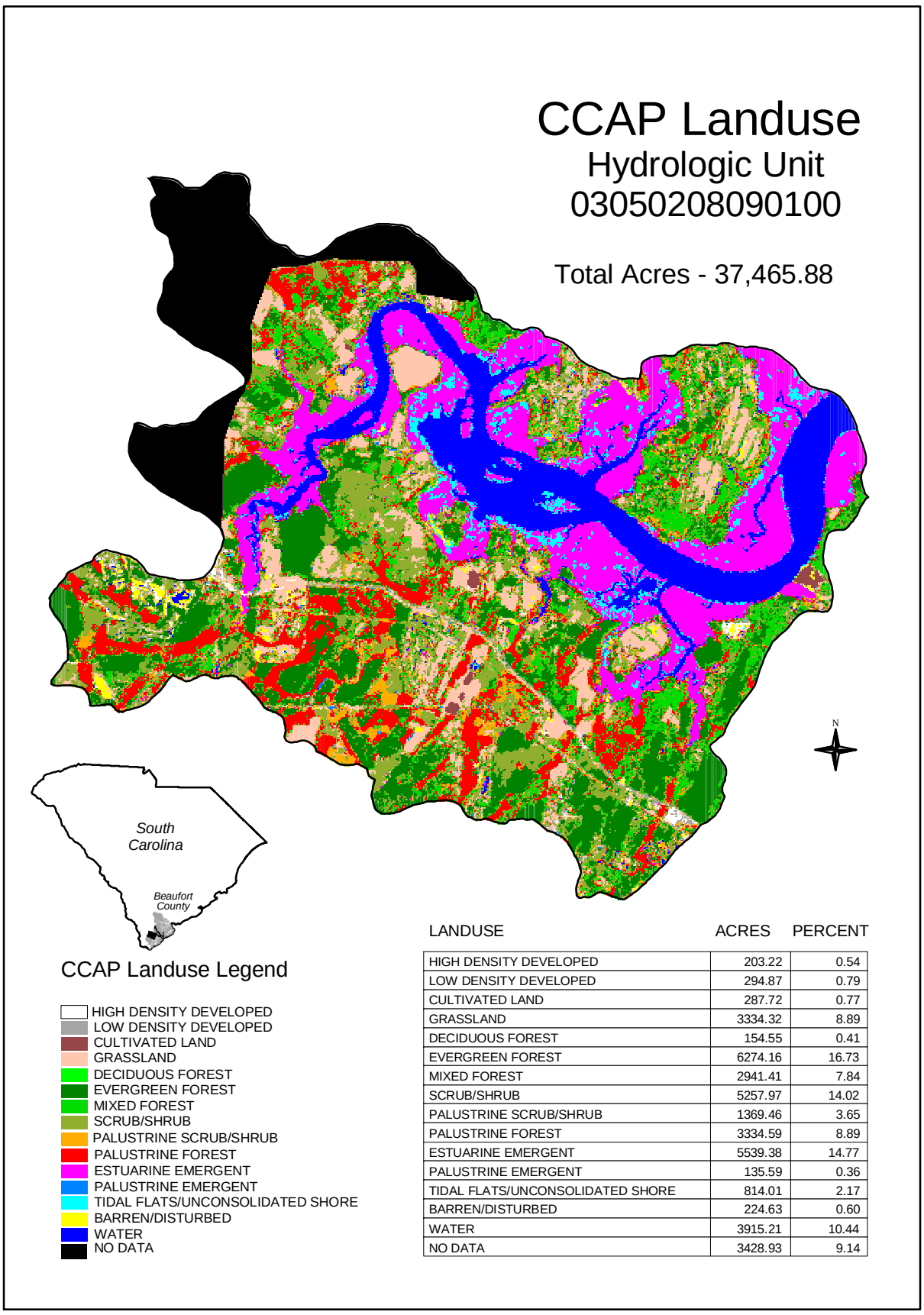
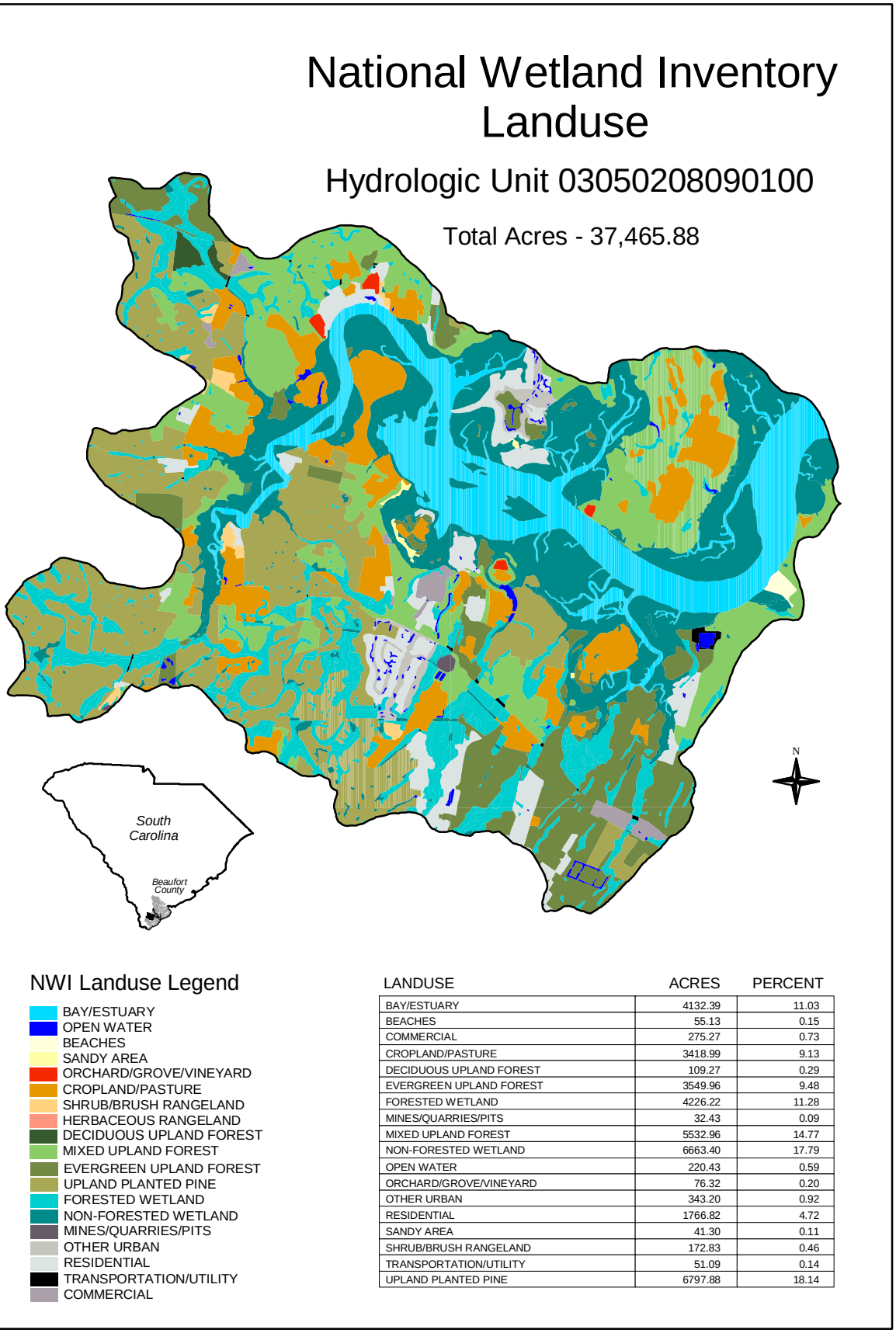


Figure 2.2. National Wetlands Inventory (NWI) landuse classification for lower Hilton Head Island watershed.



LANDUSE	ACRES	PERCENT
HIGH DENSITY DEVELOPED	203.22	0.54
LOW DENSITY DEVELOPED	294.87	0.79
CULTIVATED LAND	287.72	0.77
GRASSLAND	3334.32	8.89
DECIDUOUS FOREST	154.55	0.41
EVERGREEN FOREST	6274.16	16.73
MIXED FOREST	2941.41	7.84
SCRUB/SHRUB	5257.97	14.02
PALUSTRINE SCRUB/SHRUB	1369.46	3.65
PALUSTRINE FOREST	3334.59	8.89
ESTUARINE EMERGENT	5539.38	14.77
PALUSTRINE EMERGENT	135.59	0.36
TIDAL FLATS/UNCONSOLIDATED SHORE	814.01	2.17
BARREN/DISTURBED	224.63	0.60
WATER	3915.21	10.44
NO DATA	3428.93	9.14

Figure 2.3. Coastal Change Analysis Program (CCAP) landuse classification for the Okatee River watershed. Note unclassified portion of watershed located in Jasper County.



LANDUSE	ACRES	PERCENT
BAY/ESTUARY	4132.39	11.03
BEACHES	55.13	0.15
COMMERCIAL	275.27	0.73
CROPLAND/PASTURE	3418.99	9.13
DECIDUOUS UPLAND FOREST	109.27	0.29
EVERGREEN UPLAND FOREST	3549.96	9.48
FORESTED WETLAND	4226.22	11.28
MINES/QUARRIES/PITS	32.43	0.09
MIXED UPLAND FOREST	5532.96	14.77
NON-FORESTED WETLAND	6663.40	17.79
OPEN WATER	220.43	0.59
ORCHARD/GROVE/VINEYARD	76.32	0.20
OTHER URBAN	343.20	0.92
RESIDENTIAL	1766.82	4.72
SANDY AREA	41.30	0.11
SHRUB/BRUSH RANGELAND	172.83	0.46
TRANSPORTATION/UTILITY	51.09	0.14
UPLAND PLANTED PINE	6797.88	18.14

Figure 2.4. National Wetlands Inventory (NWI) landuse classification for the Okatee River watershed. Note Jasper County portion of watershed is included and classified.

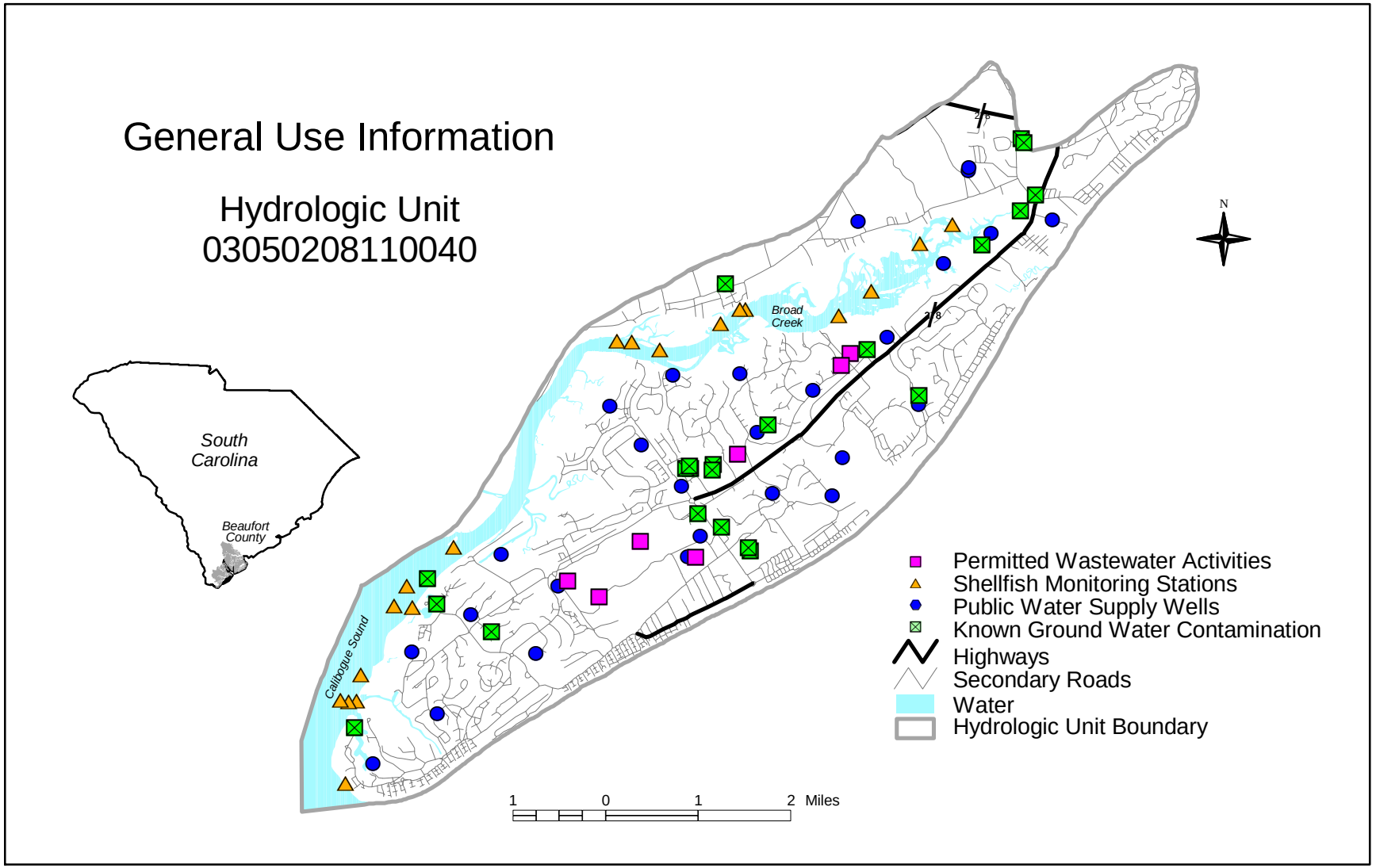


Figure 2.5. Location of other specific development related features and shellfish monitoring sites in the lower Hilton Head Island watershed (see text).

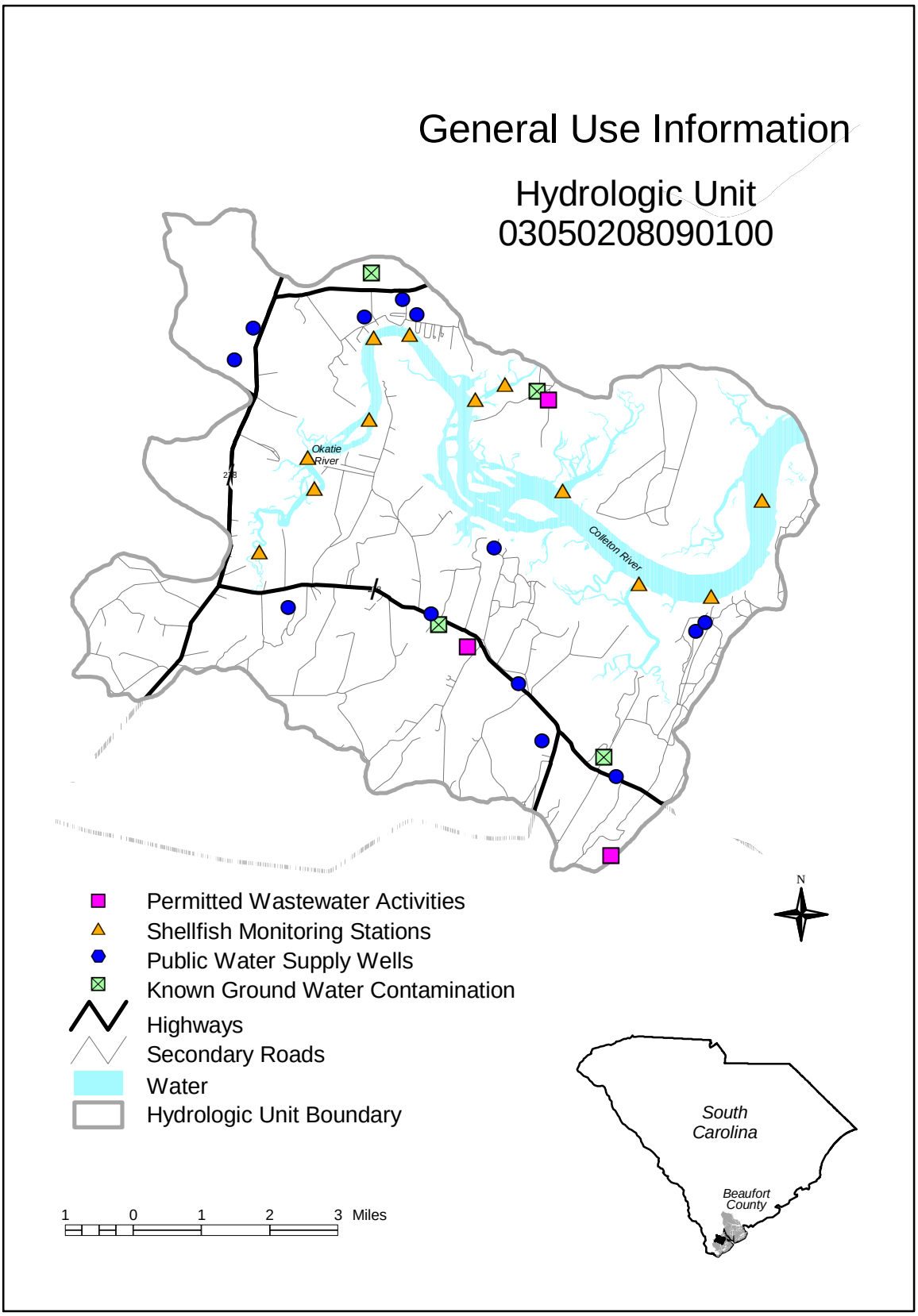


Figure 2.6. Location of other specific development related features and shellfish monitoring sites in the Okatee River watershed (see text).

Broad Creek

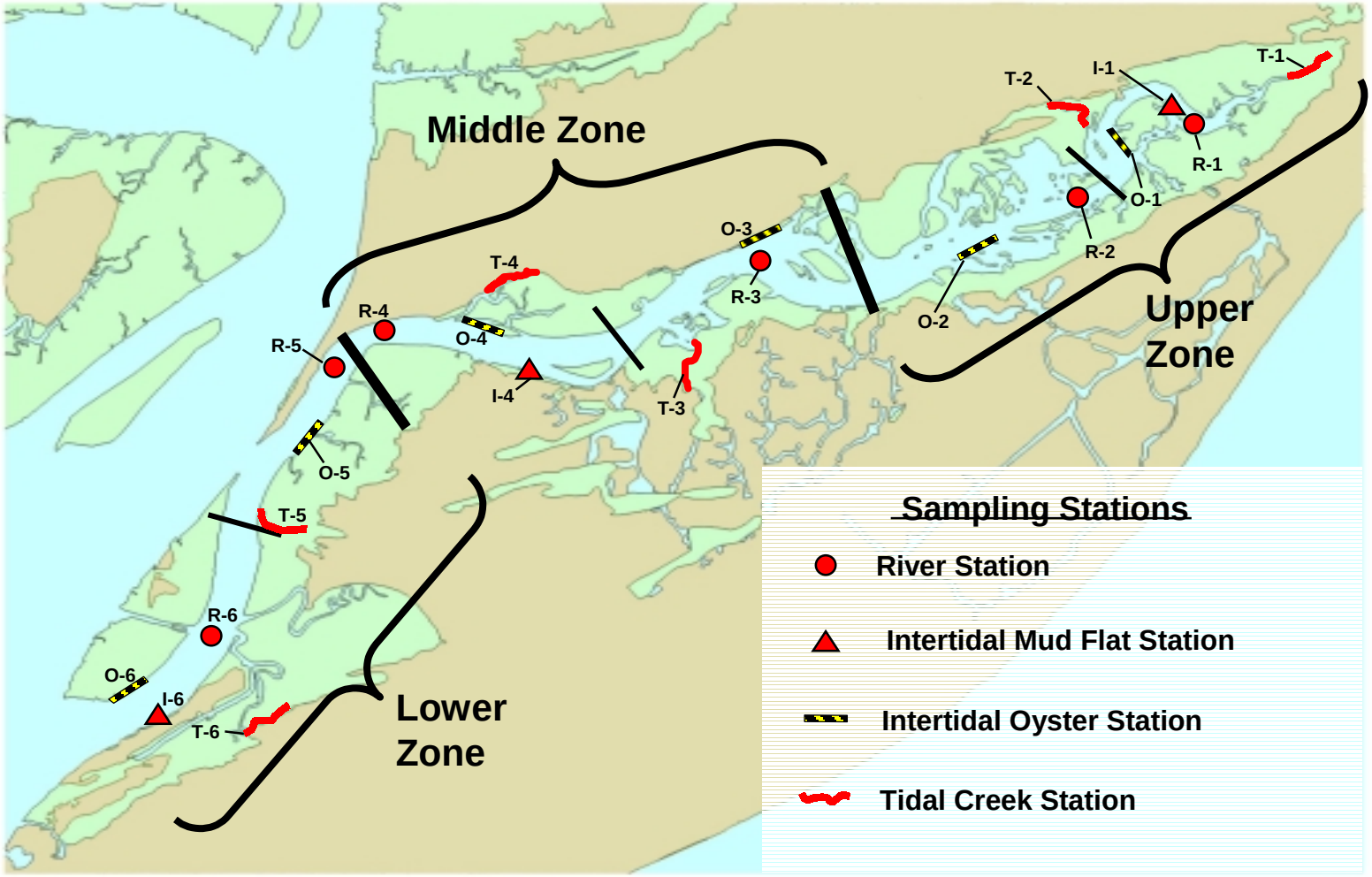


Figure 2.7. Broad Creek sample design.

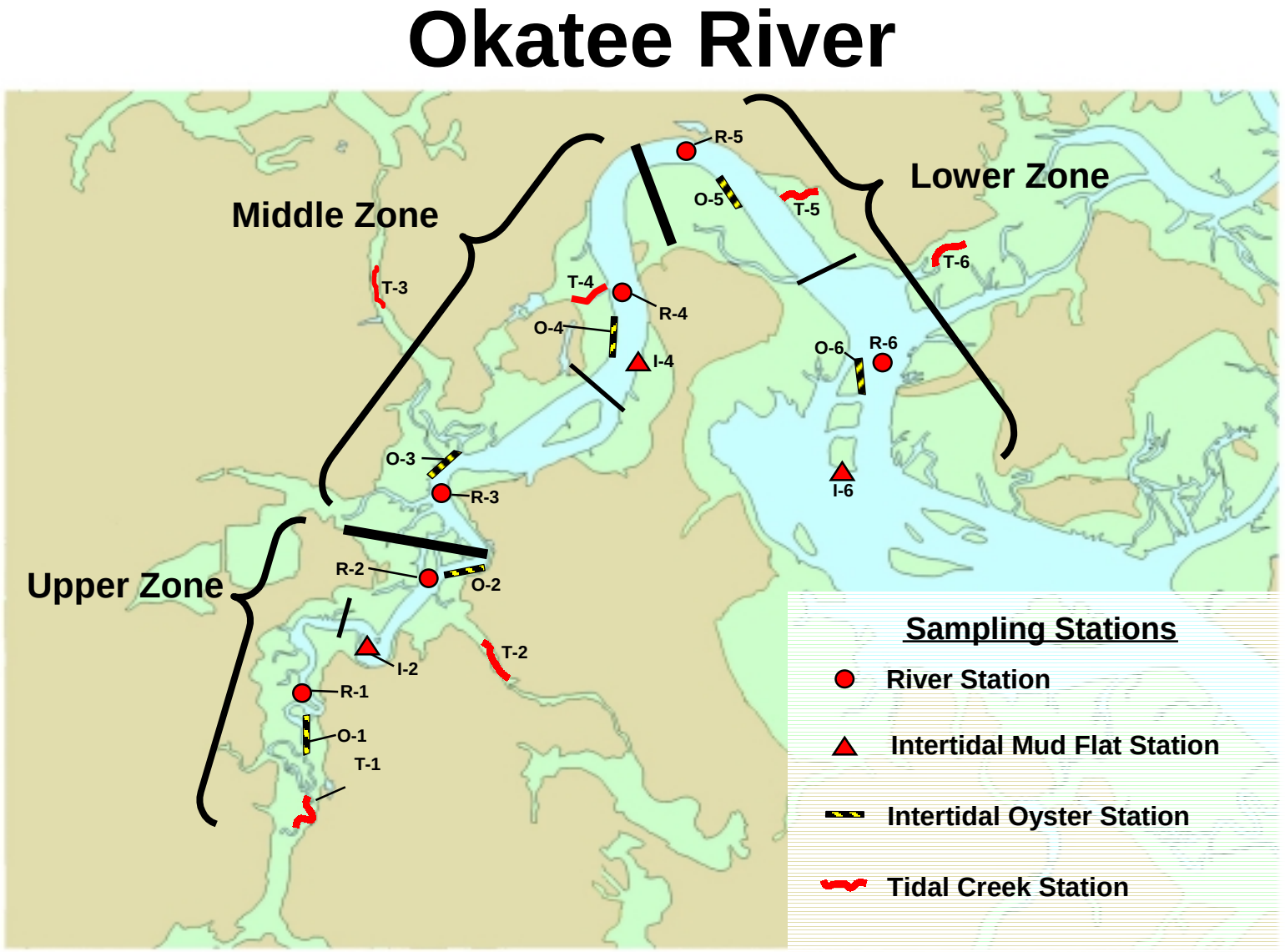


Figure 2.8. Okatee River sample design.

Table 2.1. Summary of land use characteristics for the Broad Creek and Okatee River drainage basins

	Lower Hilton Head (acres)	Lower Hilton Head (proportion)	Okatee (acres)	Okatee (proportion)
Overall Size	17,621		34,076	
Total Wet Area [1]	4,632	26%	10,268	30%
Open Water	2,514	54%	3,915	38%
Estuarine Wetland	2,118	46%	6,353	62%
Forested Wetlands [2]	618	4%	4,226	12%
Total Upland Area [2]	11,443		22,223	
Residential	7,286	64%	1,767	8%
Industrial	1,878	16%	618	3%
Agriculture	51	0.4%	3,419	15%
Upland Forest	1,891	17%	15,990	72%
Total Taxable Land Area [3]	11,479	65%	23,423	69%
Total Impervious Surface [4]	3,716	32%	3,569	15%
Transportation Related Impervious Surface [4]	1,822	16%	428	2%

[1]Coastal Change Analysis Program (CCAP)

[2]National Wetlands inventory (NWI) 1989, enhanced by 1994 aerial photography

[3]Beaufort County Tax Map Parcels

[4]CCAP modified with Tax Map Parcel Data

Table 2.2. State ND permits and National Pollutant Discharge Elimination System (NPDES) permits for the Broad Creek and Okatee River drainage basins

NPDES	Pipe #	Name	# of Spray Sites	Permitted Discharge*
Okatee River Watershed				
ND0069191	001	Beaufort-Jasper Water & Sewer Authority/Bluffton Regional WWTP	2	0.15
ND0061000	001	Beaufort-Jasper Water & Sewer Authority/Rose Hill Plantation	5	0.034
ND0062235	001	Callawassie Development	1	0.26
		Total Permitted Discharge		0.444
Broad Creek Watershed				
ND0013528	001	South Island Public Service District/Long Cove Creek	1	0.225
ND0017141	001	South Island Public Service District/Wexford Plant	1	0.227
ND0063100	001	Broad Creek Public Service District	1	1.588
ND0064033	001	South Island Public Service District	2 + reclaimed	4.15
SC0042501	001	South Island Public Service District		5
SC0042501[a]	002	South Island Public Service District		
SC0042501[a]	003	South Island Public Service District		
		Total Permitted Discharge		11.19

* in Millions of Gallons per day (MGD)

[a] Actually the discharge from wetlands receiving discharge from pipe 001

ND# = No direct discharge to a receiving stream (spray field application)

SC# = Direct discharge to a receiving stream

Table 2.3. Public Drinking Water Supply wells in the Broad Creek and Okatee River drainage basins

System	Well	Description
Okatee River Watershed		
0710003	G07185	Beaufort-Jasper Water & Sewer Authority
0710003	G07186	Beaufort-Jasper Water & Sewer Authority
0710003	G07314	Beaufort-Jasper Water & Sewer Authority
0710003	G07315	Beaufort-Jasper Water & Sewer Authority
0730009	G07160	Maggioni Seafood
0750023	G07177	Okatee River Estates
0760051	G07232	Goethes Mobile Home Park
0770115	G07263	Waddel Mariculture Center
0770675	G07274	Human Development Center
0770875	G07318	Island West
0770902	G07278	Waddel Mariculture
2760006	G27138	Bennets Mobile Home Park
2770904	G27149	Handy Dans II
Broad Creek Watershed		
0720001	G07106	Sea Pines Public Service District
0720001	G07107	Sea Pines Public Service District
0720001	G07108	Sea Pines Public Service District
0720001	G07109	Sea Pines Public Service District
0720001	G07110	Sea Pines Public Service District
0720001	G07111	Sea Pines Public Service District
0720001	G07112	Sea Pines Public Service District
0720001	G07113	Sea Pines Public Service District
0720001	G07114	South Island Public Service District
0720001	G07115	Sea Pines Public Service District
0720001	G07126	South Island Public Service District
0720001	G07127	South Island Public Service District
0720001	G07128	South Island Public Service District
0720001	G07129	South Island Public Service District
0720001	G07131	South Island Public Service District
0720001	G07175	South Island Public Service District
0720001	G07176	South Island Public Service District
0720001	G07187	South Island Public Service District
0720001	G07188	South Island Public Service District
0720006	G07124	Hilton Head Island Public Service District 1
0720006	G07125	Hilton Head Public Service District1
0720009	G07148	Broad Creek Public Service District
0720009	G07149	Broad Creek Public Service District
0720009	G07150	Broad Creek Public Service District
0750020	G07173	Hilton Head Island Utilities III
0760053	G07233	Broad Creek Mhp
0770228	G07267	Abes Restaurant
0770851	G07351	Hilton Head Marina

Table 2.4. Known contaminated groundwater sites in the Broad Creek and Okatee River drainage basins

ID	Description	UST ID	FEATURE
Okatee River Watershed			
606	Beaufort Country Store	15888	UST
590	Callawassie Golf Course	05262	UST
2835	Rose Hill Plantation	00358	OTHER
2370	SCE&G Crew Qtr	00907	UST
Broad Creek Watershed			
2893	Bird Oil Co	13287	AST
2594	Broad Creek Marina	10362	UST
596	Circle K 8100	00992	UST
604	Circle Mobil Station	01006	UST
592	Exxon	01052	UST
603	Harbour Towne Yacht	11753	UST
2589	Hilton Head Texaco	12808	UST
2596	Island Chevron 50172	00975	UST
2597	Island Tire Service	01005	UST
2591	Long Cove Club Assoc	12740	UST
2590	Palmetto Dunes	01022	UST
593	Pantry Store	12174	UST
594	Pantry Store	00995	UST
2598	Plantation Station	18038	UST
2599	Sea Pines Forrest Beach	00922	UST
2895	Sea Pines Plantation	00094	OTHER
1867	Seabrook Of Hilton Head	15372	UST
2595	Singletons Amoco	00978	UST
2592	Sommers 52	12805	UST
602	South Beach Marina	14368	UST
595	Speedway 39	01025	UST
611	Starvin Marvin 106	01027	UST

UST = Underground Storage Tank
AST = Above Ground Storage Tank